β^* Measurement at D0

Avdhesh Chandra

UNIVERSITY of CALIFORNIA Riverside

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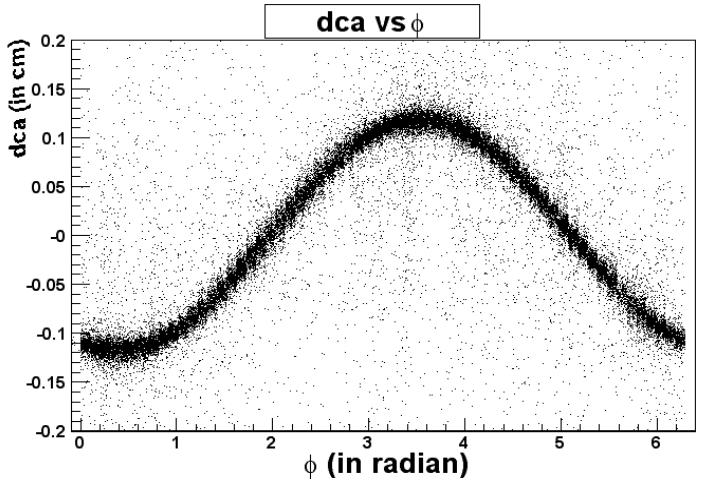
The Method

- Interaction region is from -40cm to +40cm on z-axis, dividing data in slices of 5 cm each on z-axis, total 16 division (say z-region)
- For each z-region, dca vs ϕ plot is of sinusoidal shape because of

$$dca = y_v\cos\phi - x_v\sin\phi$$



$$\langle d_1 d_2 \rangle = \tfrac{1}{2}(\sigma_2^2 - \sigma_1^2)\cos 2\Phi + \tfrac{1}{2}(\sigma_2^2 + \sigma_1^2)\cos\Delta\Phi - T\sin 2\Phi$$

where, σ_1 , σ_2 and T are parameters

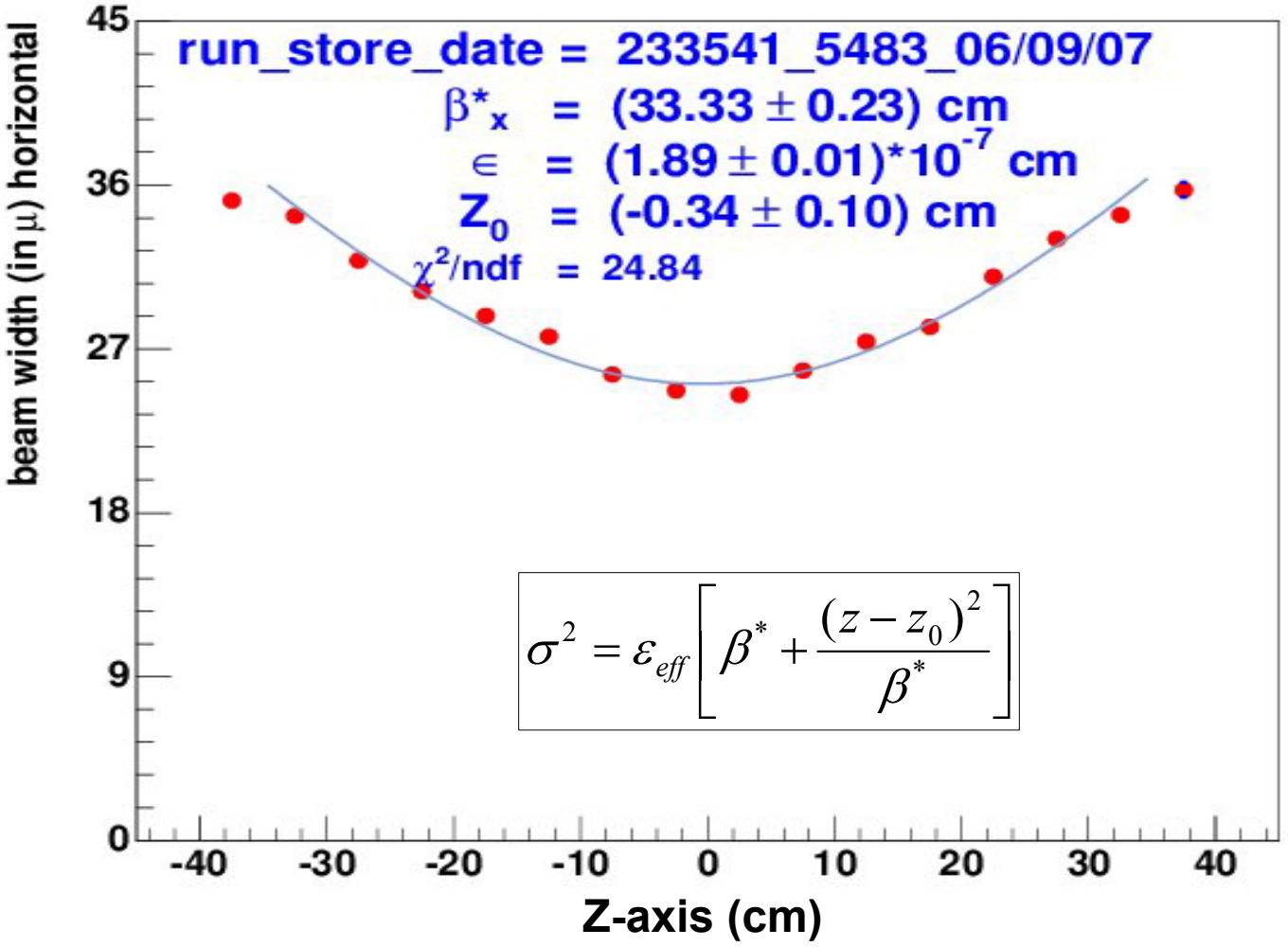
- x_v & y_v → (x, y) coordinate of the vertex
- d_1 & d_2 → impact parameter of two tracks from the same vertex
- σ_1 & σ_2 → beam width in horizontal and vertical plane
- T → correlation between σ_1 & σ_2

The interaction region is a drift in the Tevatron, z dependence of beam width given by following formula

$$\sigma^2 = \varepsilon_{eff}\left[\beta^* + \frac{(z - z_0)^2}{\beta^*}\right]$$

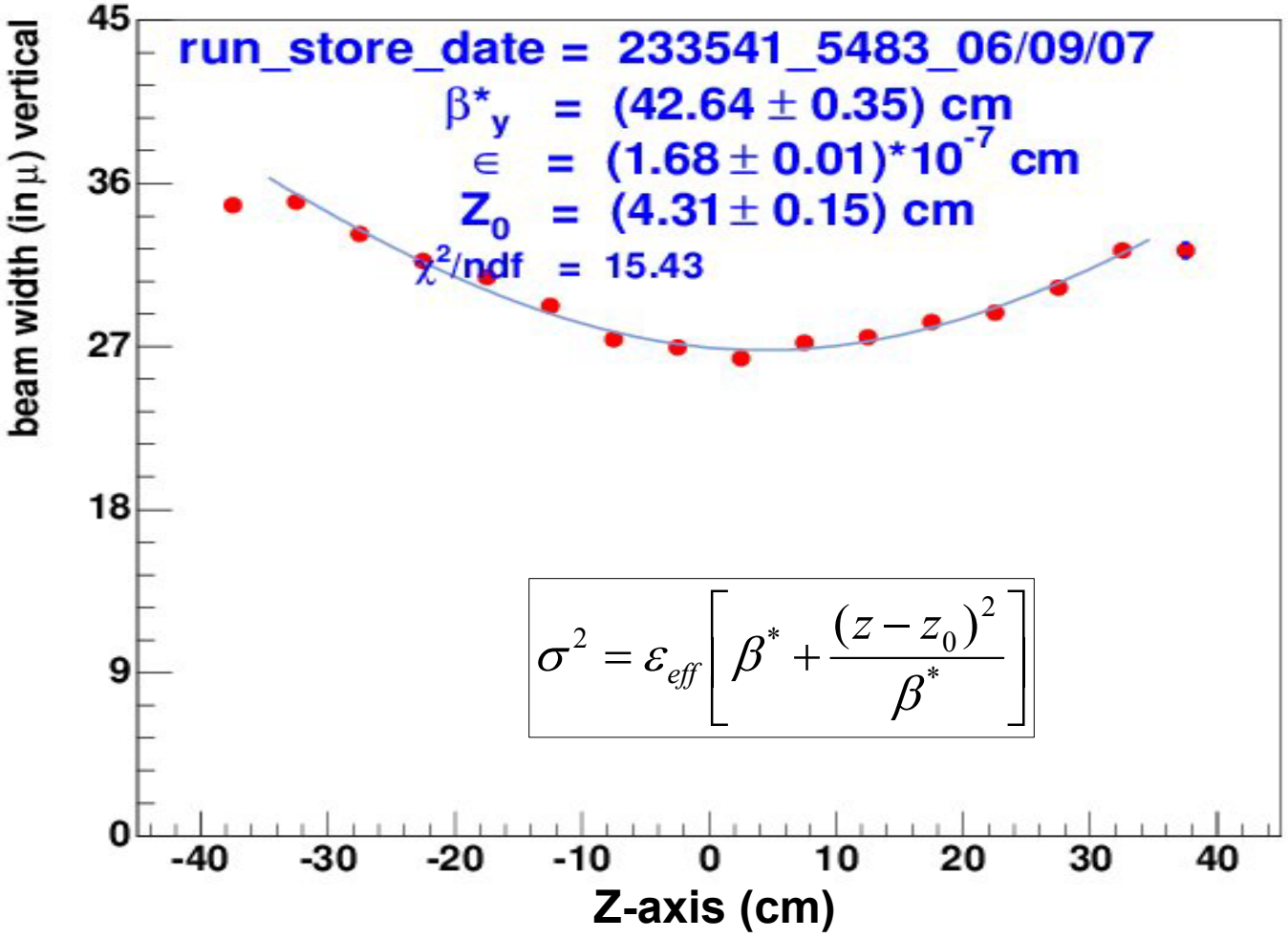
$\sigma_x \rightarrow \beta^*_x$

Red dots corresponds to beam width in horizontal plane (in micron m)

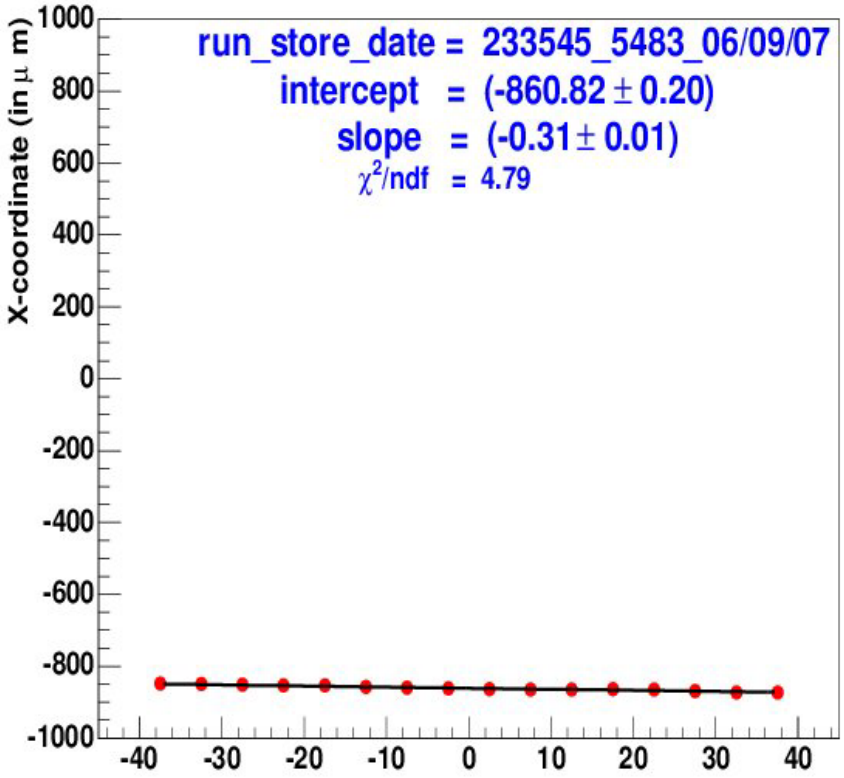


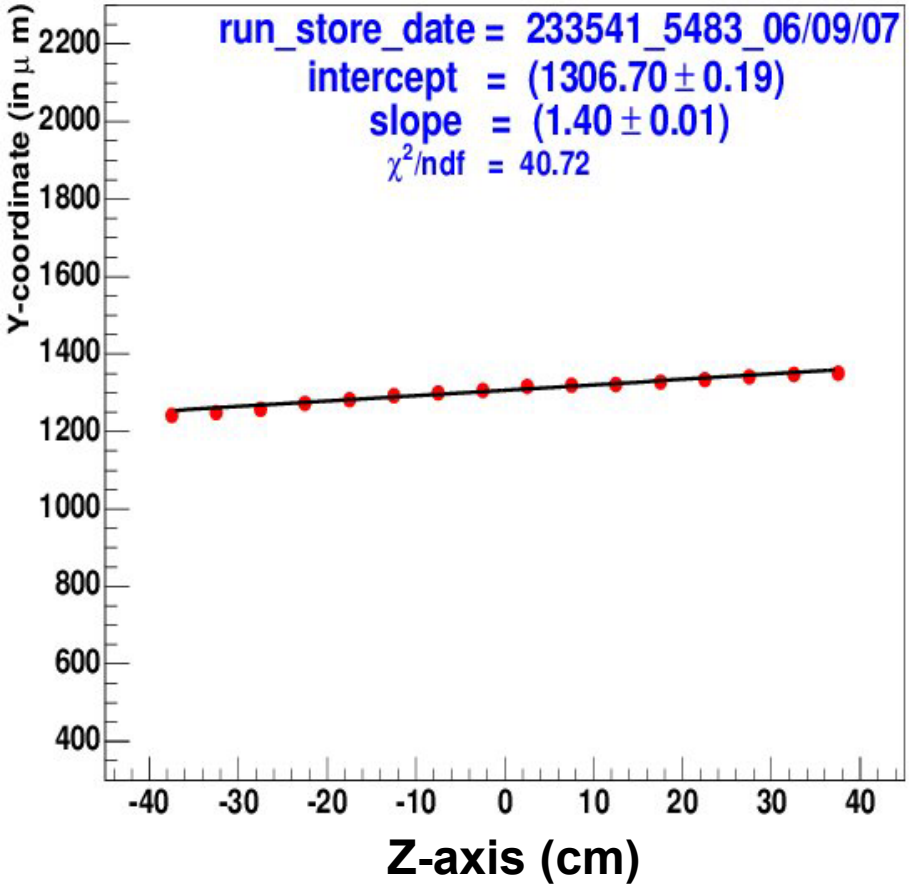
$\sigma_y \rightarrow \beta^*_y$

Red dots corresponds to beam width in vertical plane (in micron m)

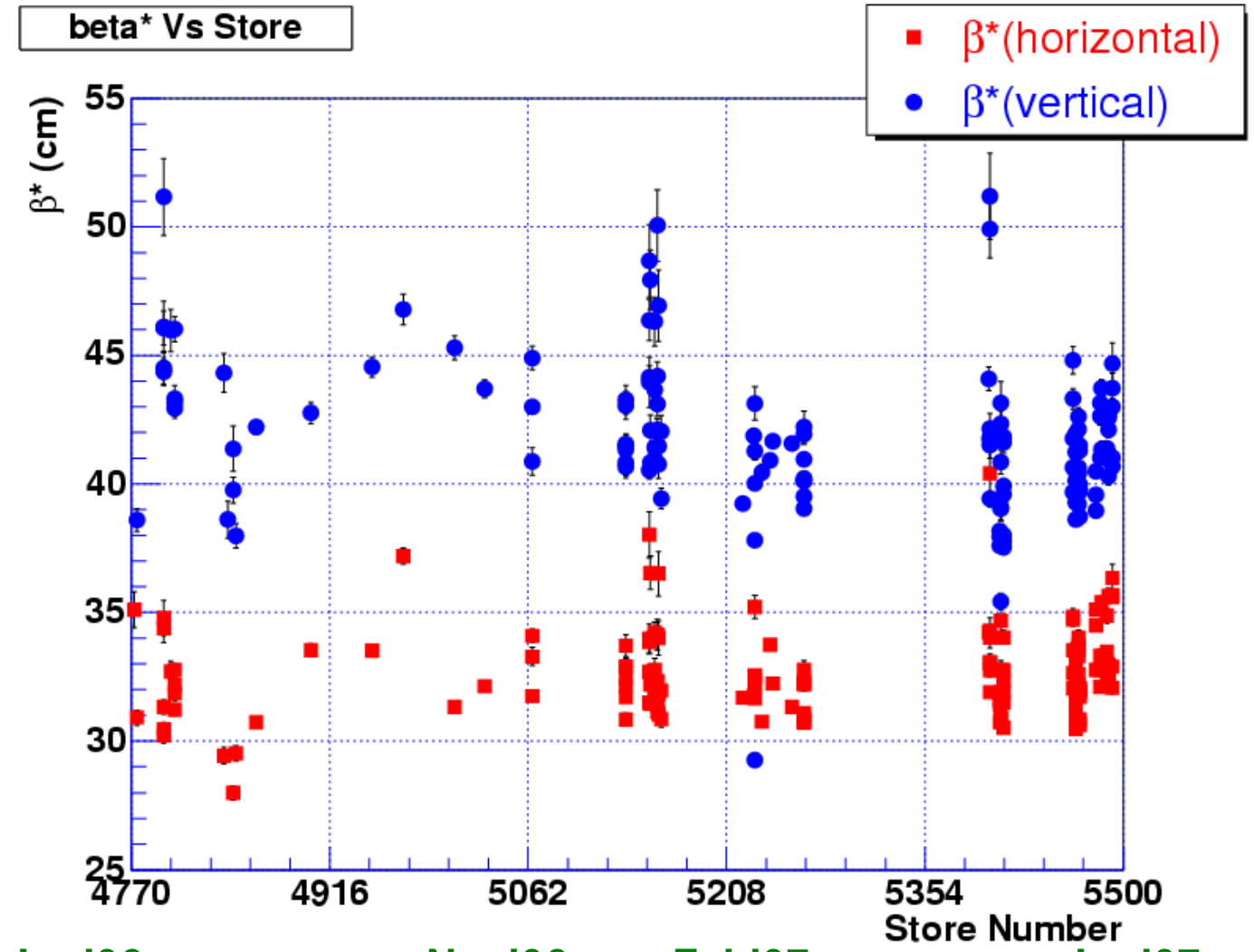


X/Y coordinate vs. Z

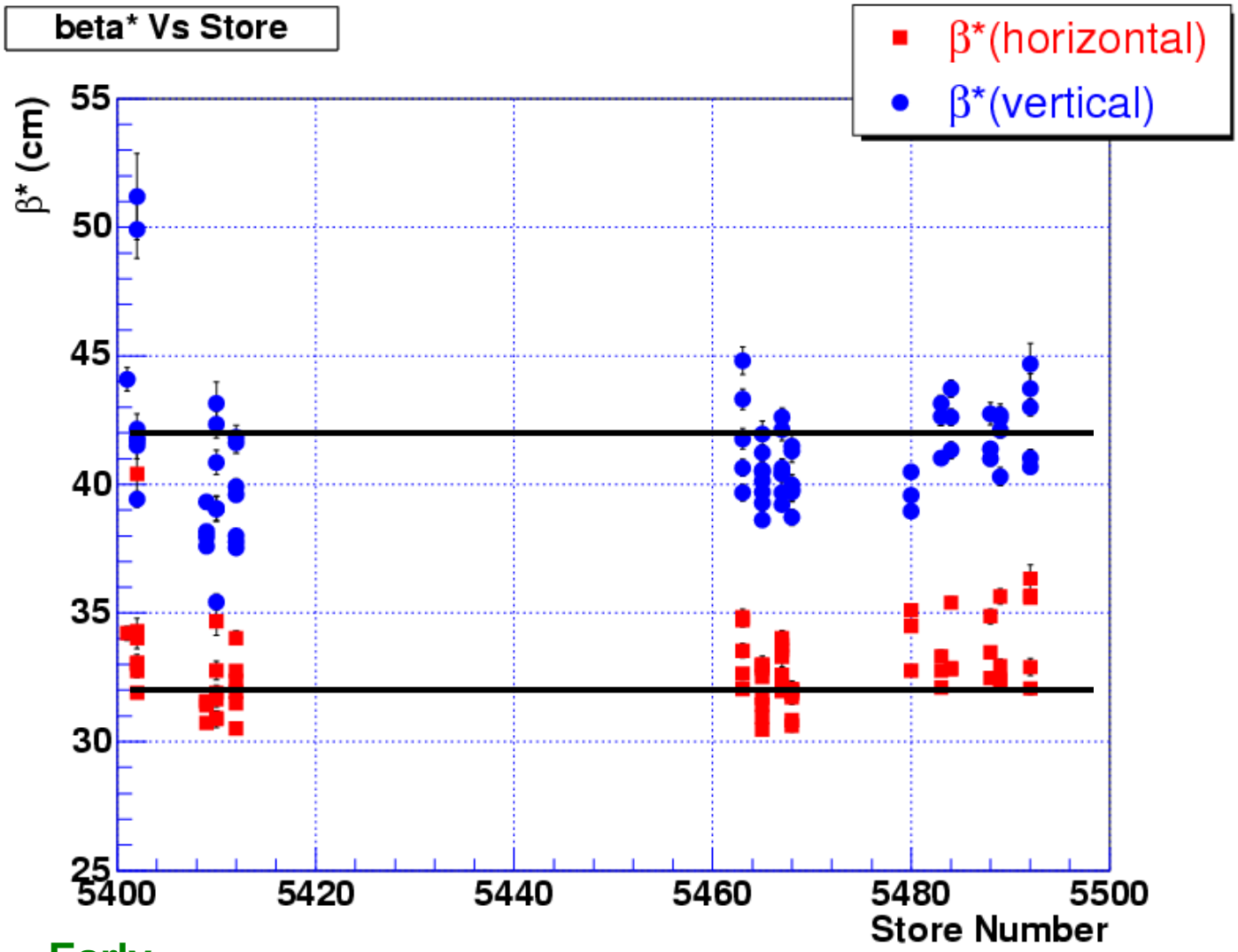




β^* vs. Stores



β^* vs. recent stores

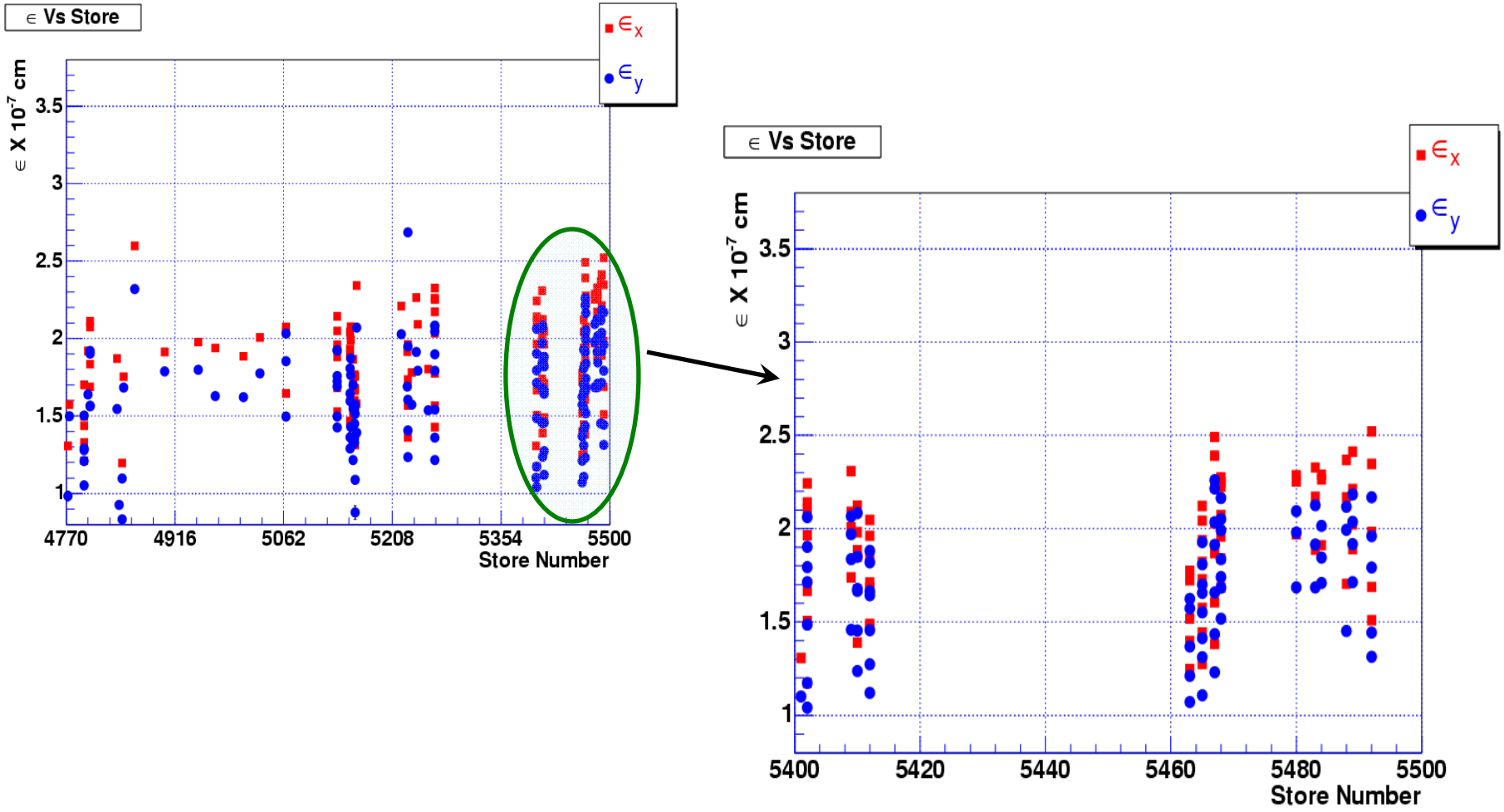


Early May'07

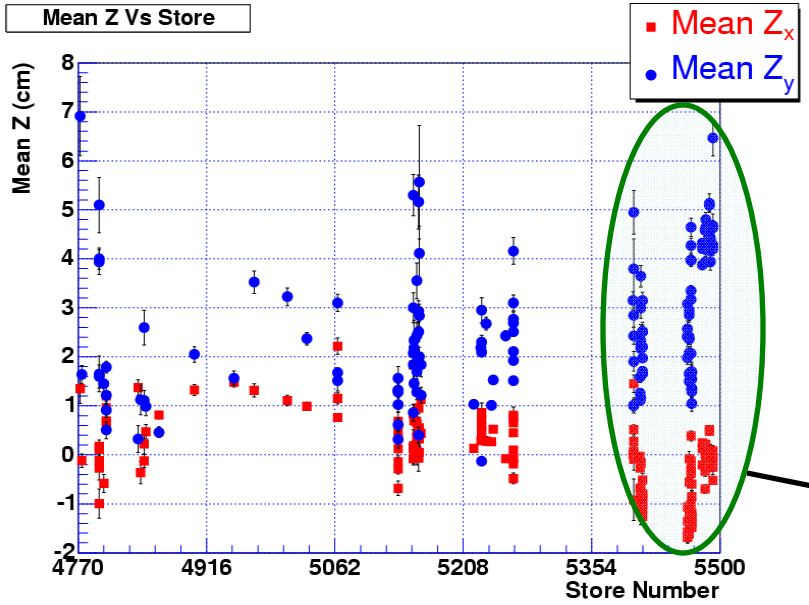
End May'07

Mid Jun'07

ε vs. Stores

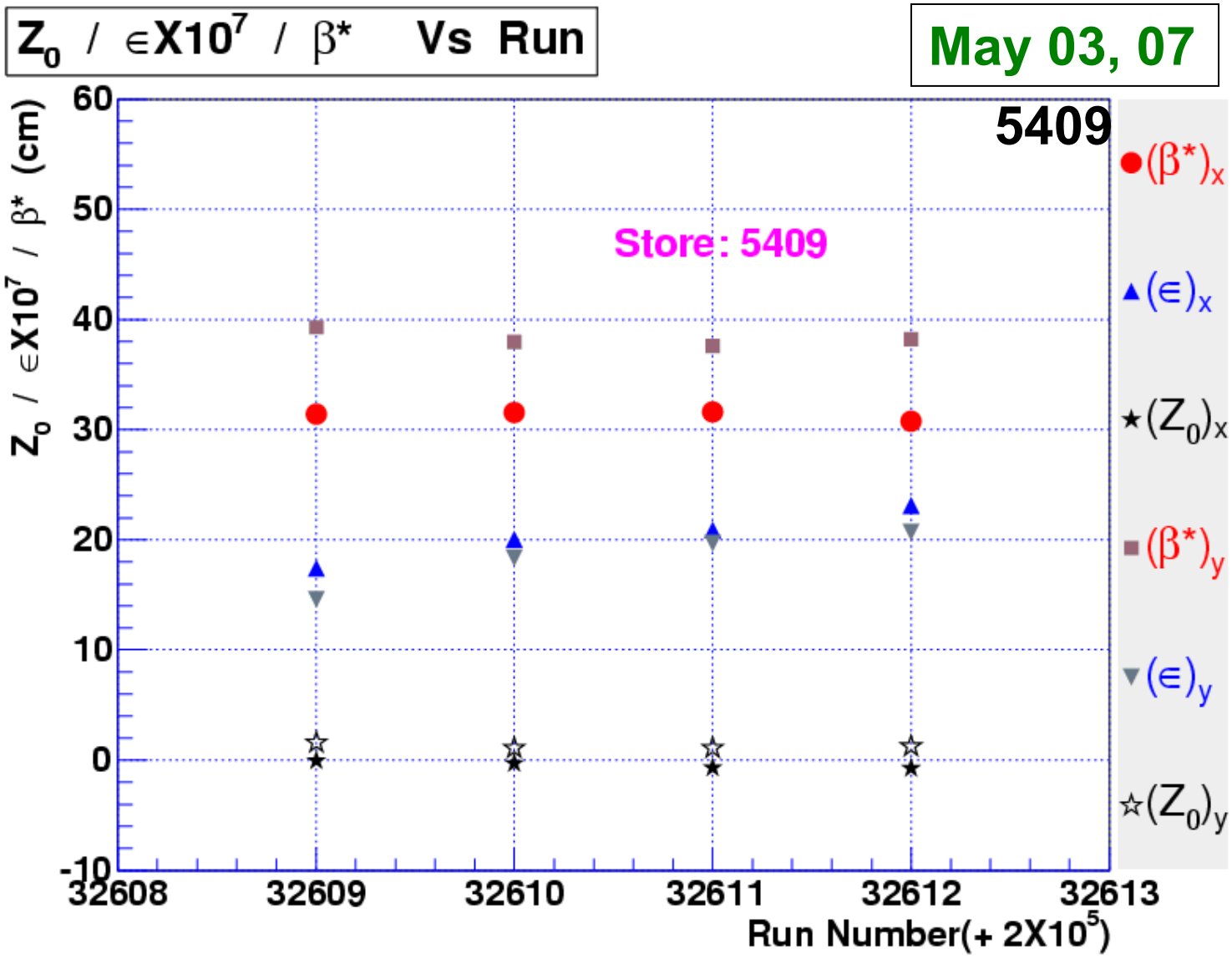

∈ Vs Store
ϵ_x
ϵ_y
∈ X 10^{-7} cm
3.5
3
2.5
2
1.5
1
4770
4916
5062
5208
5354
5500
Store Number
∈ Vs Store
ϵ_x
ϵ_y
∈ X 10^{-7} cm
3.5
3
2.5
2
1.5
1
5400
5420
5440
5460
5480
5500
Store Number

Z_0 vs. Stores

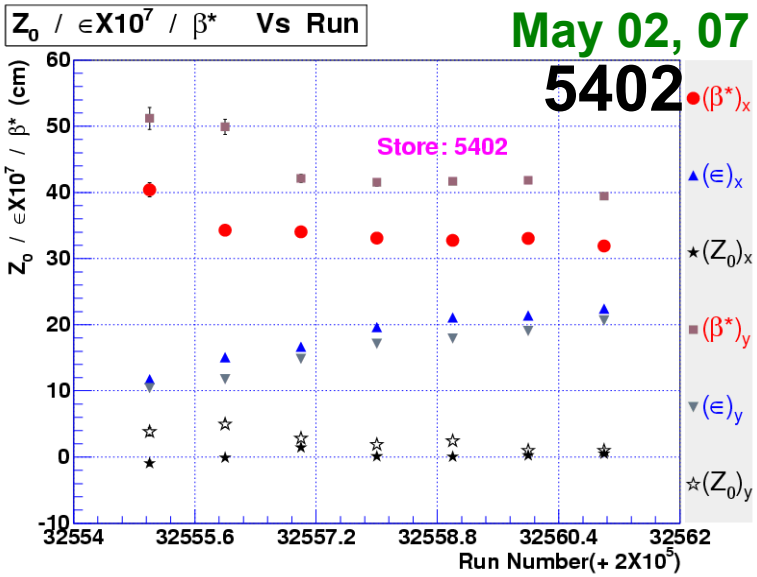

Mean Z Vs Store
Mean Z_x
Mean Z_y
Mean Z (cm)
8
7
6
5
4
3
2
1
0
-1
-2
4770
4916
5062
5208
5354
5500
Store Number

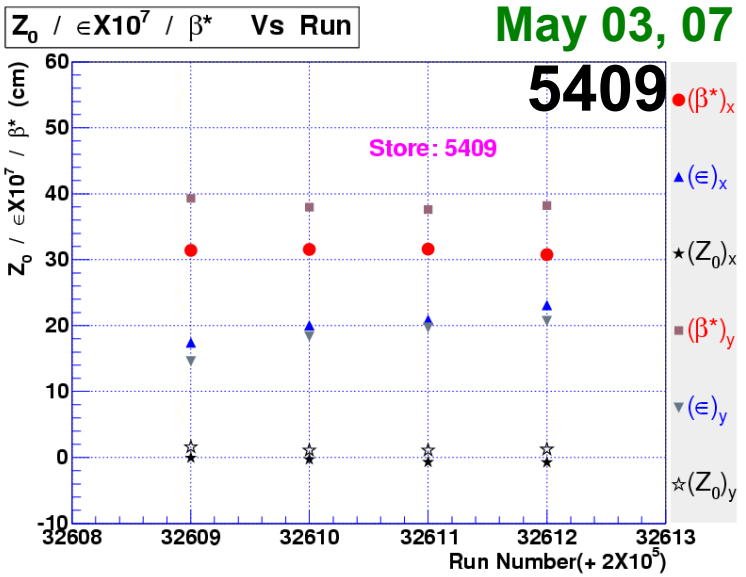

Mean Z Vs Store
Mean Z_x
Mean Z_y
Mean Z (cm)
8
7
6
5
4
3
2
1
0
-1
-2
5400
5420
5440
5460
5480
5500
Store Number

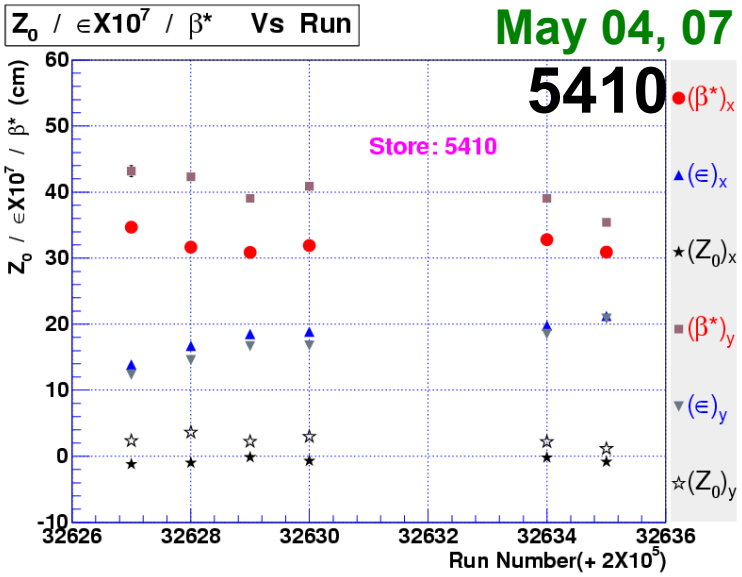
In a Store

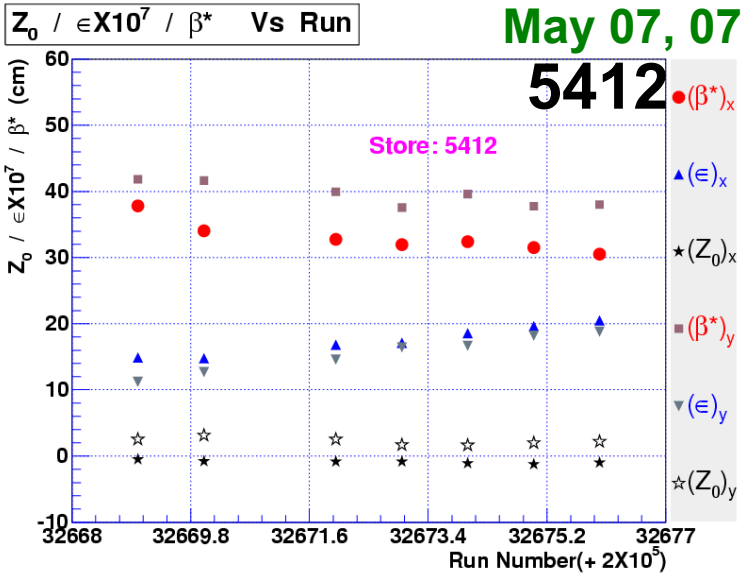

Z_0 / $\epsilon X10^7$ / β^* Vs Run
May 03, 07
5409
Store: 5409
Z_0 / $\epsilon X10^7$ / β^* (cm)
60
50
40
30
20
10
0
-10
32608
32609
32610
32611
32612
32613
Run Number(+ $2X10^5$)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

In a Store

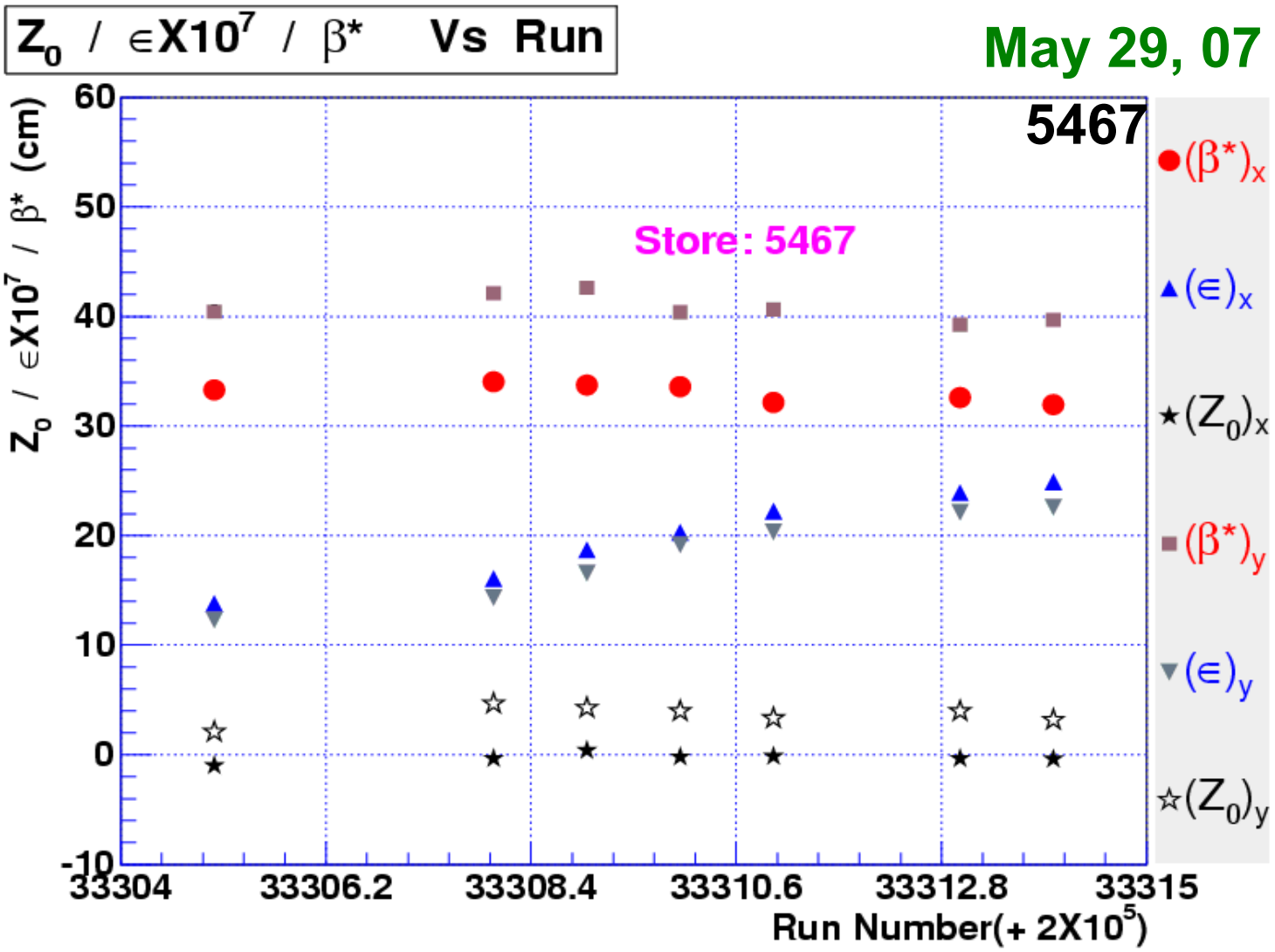

Z_0 / $\epsilon X10^7$ / β^* Vs Run
May 02, 07
5402
Store: 5402
Z_0 / $\epsilon X10^7$ / β^* (cm)
Run Number(+ $2X10^5$)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$


Z_0 / $\epsilon X10^7$ / β^* Vs Run
May 03, 07
5409
Store: 5409
Z_0 / $\epsilon X10^7$ / β^* (cm)
Run Number(+ $2X10^5$)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

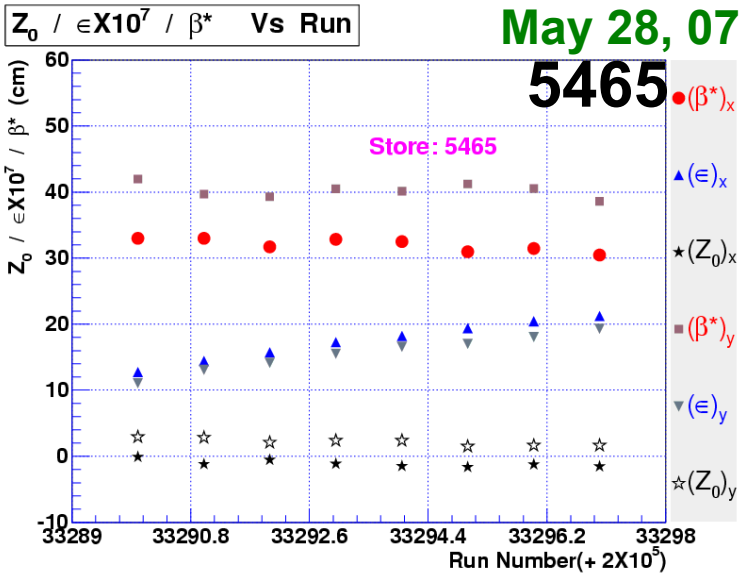

Z_0 / $\epsilon X10^7$ / β^* Vs Run
May 04, 07
5410
Store: 5410
Z_0 / $\epsilon X10^7$ / β^* (cm)
Run Number(+ $2X10^5$)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

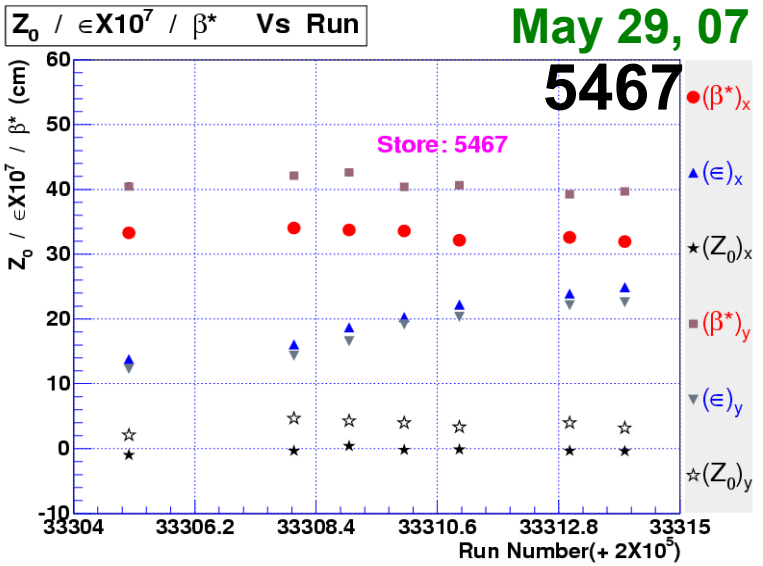

Z_0 / $\epsilon X10^7$ / β^* Vs Run
May 07, 07
5412
Store: 5412
Z_0 / $\epsilon X10^7$ / β^* (cm)
Run Number(+ $2X10^5$)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

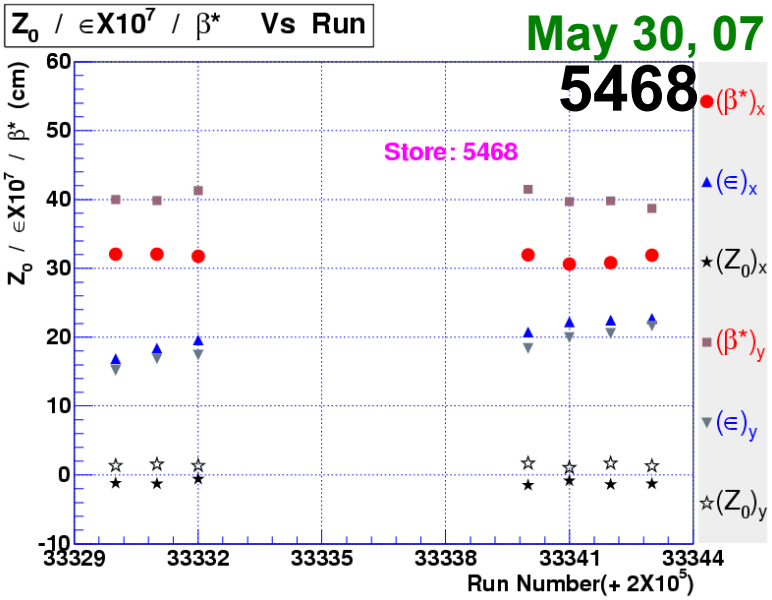
In a Store

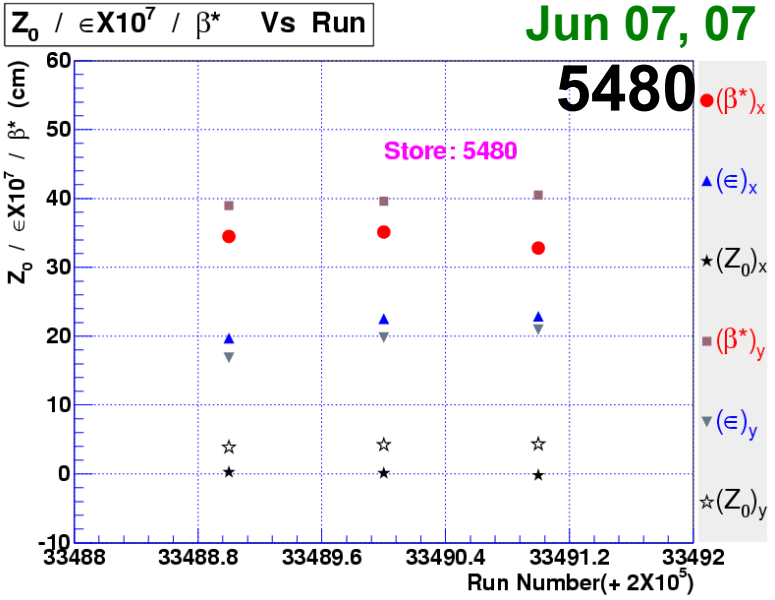

Z_0 / ϵX10^7 / β^* Vs Run
May 29, 07
5467
Store: 5467
Z_0 / ϵX10^7 / β^* (cm)
60
50
40
30
20
10
0
-10
33304
33306.2
33308.4
33310.6
33312.8
33315
Run Number(+ 2X10^5)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

In a Store

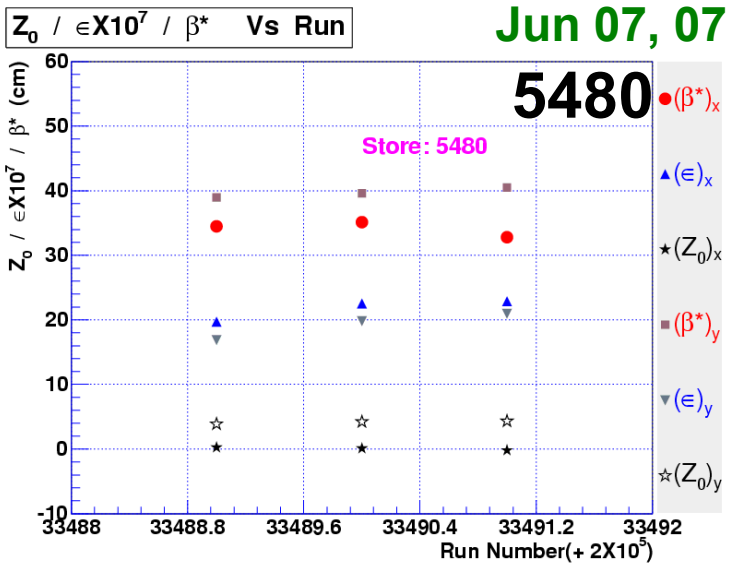

Z_0 / ϵX10^7 / β^* Vs Run
May 28, 07
5465
Store: 5465
Z_0 / ϵX10^7 / β^* (cm)
Run Number(+ 2X10^5)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

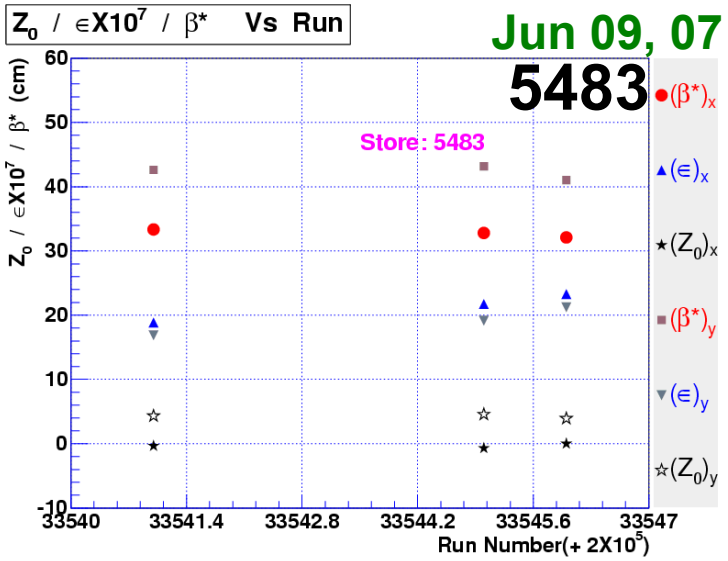

Z_0 / ϵX10^7 / β^* Vs Run
May 29, 07
5467
Store: 5467
Z_0 / ϵX10^7 / β^* (cm)
Run Number(+ 2X10^5)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

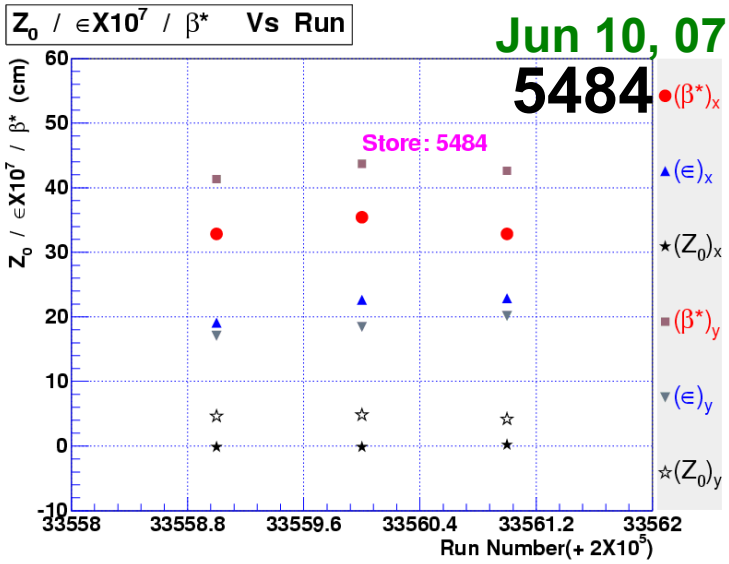

Z_0 / ϵX10^7 / β^* Vs Run
May 30, 07
5468
Store: 5468
Z_0 / ϵX10^7 / β^* (cm)
Run Number(+ 2X10^5)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

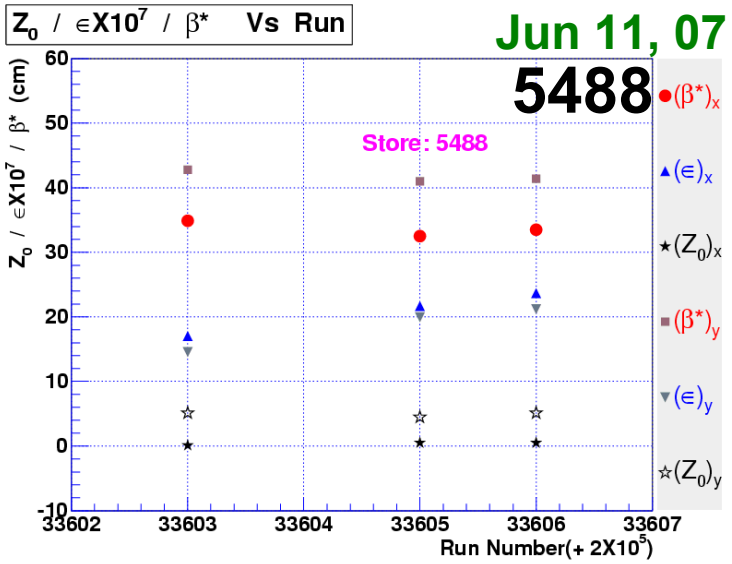

Z_0 / ϵX10^7 / β^* Vs Run
Jun 07, 07
5480
Store: 5480
Z_0 / ϵX10^7 / β^* (cm)
Run Number(+ 2X10^5)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

In a Store


Z_0 / $\epsilon X10^7$ / β^* Vs Run
Jun 07, 07
5480
Store: 5480
Z_0 / $\epsilon X10^7$ / β^* (cm)
Run Number(+ 2X10^5)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$


Z_0 / $\epsilon X10^7$ / β^* Vs Run
Jun 09, 07
5483
Store: 5483
Z_0 / $\epsilon X10^7$ / β^* (cm)
Run Number(+ 2X10^5)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$


Z_0 / $\epsilon X10^7$ / β^* Vs Run
Jun 10, 07
5484
Store: 5484
Z_0 / $\epsilon X10^7$ / β^* (cm)
Run Number(+ 2X10^5)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$


Z_0 / $\epsilon X10^7$ / β^* Vs Run
Jun 11, 07
5488
Store: 5488
Z_0 / $\epsilon X10^7$ / β^* (cm)
Run Number(+ 2X10^5)
$(\beta^*)_x$
$(\epsilon)_x$
$(Z_0)_x$
$(\beta^*)_y$
$(\epsilon)_y$
$(Z_0)_y$

Summary

- Measurement shows that β^*_x and β^*_y did not change significantly from last reported measurement.
- Sextupole implementation (near store 5467 & 5480) not affected the β^*_x / β^*_y.
- The average value of β^*_x is ~35cm and β^*_y is ~42cm with some fluctuations.
- Updated results are available at:

  http://www-clued0.fnal.gov/~avdhesh/Beam_main.html